Central European Review of Economic Issues
EKONOMICKÁ REVUE

Age, academic career and scientific performance of Czech economists

Tomáš WROBLOWSKÝ, VŠB-TU Ostrava[i]

Abstract

There have been many papers (both theoretical and empirical) in last hundred years, which tried to explain the relationship between age and scientific output in the academia. Although most of those papers conclude that the productivity of scientists' declines after reaching certain age and then continuously declines, there is still no agreement about factors, which stand behind the reverse U-shaped age-productivity curve. The aim of this paper is to summarize the theoretical arguments, which may explain the declining productivity of scientists in later phases of their life cycle. Moreover, it provides preliminary analysis of relationship between age and scientific output of Czech economists. Because the recent studies do not take age as relevant factor influencing the scientific performance, an alternative approach examining productivity dependency upon the phase of academic career is also provided.

Keywords

Life Cycle, Publication Activity, Scientific Performance, Scientometrics.

JEL Classification: Z13, A14

[i] Department of Economics, Faculty of Economics, VŠB-Technical University of Ostrava, Sokolská 33, 701 21 Ostrava, Czech Republic.
tomas.wroblowsky@vsb.cz
This paper was written as a part of research project *Research Activities and Relationship Networks in the Czech Community of Academic Economists* (GA402/07/0342), financed by the Czech Science Foundation. The author is grateful to the participants of the conference New Trends, New Ideas (Znojmo, November 2008) for their ideas on earlier draft of this paper, and two anonymous referees for their helpful comments. The usual disclaimer applies.

1. Introduction

Charles Darwin was 29 when he developed the theory of natural selection and Albert Einstein was 26 when he developed the theory of relativity. Isaac Newton started working on his famous theory of gravitation when he was only 24 years old. Moreover, in the field of economics, Robert Barro re-launched the debate about the impact of debt-financed tax cuts when he was 29, as well as the Nobel Prize laureate James Tobin, who published his famous paper *Liquidity Preference and Monetary Policy* in the same age. John Nash started his work on his theory of non-cooperative games even when he was just 22. Gary Becker, Franco Modigliani, Robert Solow or Harry Markowitz also started their work, later awarded with Nobel Prize, when they were not older than thirty. These facts can support the belief that scientific output[1] (quality as well as quantity) is negatively correlated with age.

There have been many papers (both theoretical and empirical) in the last hundred years, which tried to explain the relationship between age and scientific output in the academia. Although most of those papers

[1] Working in academia contains lots of activities, such as teaching, research or other activities. For the purpose of this paper, the term *scientific productivity* means only productivity in the field of research. Thus, the *product* is measured by the number of papers published by the scientist.

ISSN 1212-3951
ER-CEREI, Volume 13: 201–206 (2010).
doi:10.7327/cerei.2010.12.02

conclude that the productivity of scientists declines after reaching certain age and then continuously declines, there is still no agreement about the factors, which stand behind the reverse U-shaped age-productivity curve.

The aim of this paper is to summarize the theoretical arguments, which may explain the declining productivity of scientists in later phases of their life cycle. Moreover, it provides preliminary analysis of relationship between age and scientific output of Czech economists. Because the recent studies do not take age as relevant factor influencing the scientific performance, an alternative approach examining productivity dependency upon phase of academic career is also provided.

2. The age – productivity relationship: theoretical background

Probably the first researcher to explore the relationship between scientific productivity and age was American physician George M. Beard (Beard, 1874, 1881). According to his research, the productivity of scientists grows to the age of forty and then gradually declines. He stated that, *seventy percent of the work of the world is done before 45 and eighty percent before 50* (Beard, 1881). Beard also named the decades of scientist's life according to the productivity in each decade. He called the decades *brazen*, *golden*, *silver*, *iron*, *tin* and *wooden*. The graphical illustration of the age-performance relationship (later called as *Beard's law*) is reproduced in Figure 1.

According to Beard's view, the shape of the productivity curve is a result of physical ageing of the human body. He stated that human productivity (both physical and intellectual) declines with age because *…the nervous, muscular, and osseous systems rise, remain and fall together* (Beard, 1881). Although Beard's arguments can seem very weak from today's point of view, it must be said that he was the first and for 70 years the only scientist who examined the relationship between the age and productivity.

One of the most cited publications which support Beard's view is Lehman (1953). Although Lehman's research methodology has been criticized in the past, his results and conclusions are still accepted. Lehman examined all discoveries listed in prominent histories of science and constructed charts showing the number of discoveries made in each five-years period. He found that more discoveries are made by young scientists than by old ones. His methodology was criticized (among others) by Cole (1979). Cole points out that Lehman did not take into account the number of scientists in each age group. The result is that, *…instead of asking what proportion of scientists in different age groups make important discoveries, he asked what proportion of important discoveries were made by scientists of different ages*. Thus, Lehman's results are not evidence (but also they are not contradictory) of the conclusion that age has causal influence on scientific productivity.

For the purpose of this paper, mentioning Lehman's book is essential. Lehman was the first who aimed his research at economists.[2] According to his research, economists as well as other scientists publish most after the beginning of their career (around 35) and then their productivity declines.

After Lehman, a significant amount of papers dealing with the relationship between age and productivity appeared. Among others, Zuckerman and Merton (1972), Cole (1979), Diamond (1984), Colander (1989), Goodwin and Sauer (1995), Oster and Hamermesh (1998) or Breschi et al. (2004) can be mentioned. While some of those papers confirm the validity of Beard's law, some provide opposite results. Before providing results of my own research, it will be useful to summarize arguments of both advocates and opponents of the reversed U-shape productivity curve.

The oldest arguments of Beard's law advocates are physical and intellectual attributes of human being. As stated before, especially earlier studies (Beard, Lehman) put stress on these factors. In older age, the flexibility, psychical vigor, energy and resistance to fatigue continuously decline, but all these attributes are essential for creative work. Also the probability of serious illness increases with the age.[3]

Different arguments appeared after Gary Becker's *human capital revolution*. Human capital investments provide decreasing return. If we assume the marginal cost of publishing a paper (measured for example with the loss of leisure) being equal for young and old scientists, the marginal revenues from used effort are much lower for the older scientists. Thus, it motivates the younger scientists to working on research and publishing books and papers instead of using leisure.

Some authors (for example Diamond, 1984, Goodwin and Sauer 1995, Dalen, 1997a) state that the decline in productivity is not caused by the age itself, but rather by the phase of scientist's academic career. There are several events, which usually happen in

[2] However, it should be noted that productivity of economists was not examined separately, but together with political science.

[3] Lehman (1953) offers sixteen reasons why higher publication activity can be expected especially in the first part of the life cycle. Some of them seem to be very obscure (for example unhappy marriages and a maladjusted sex life).

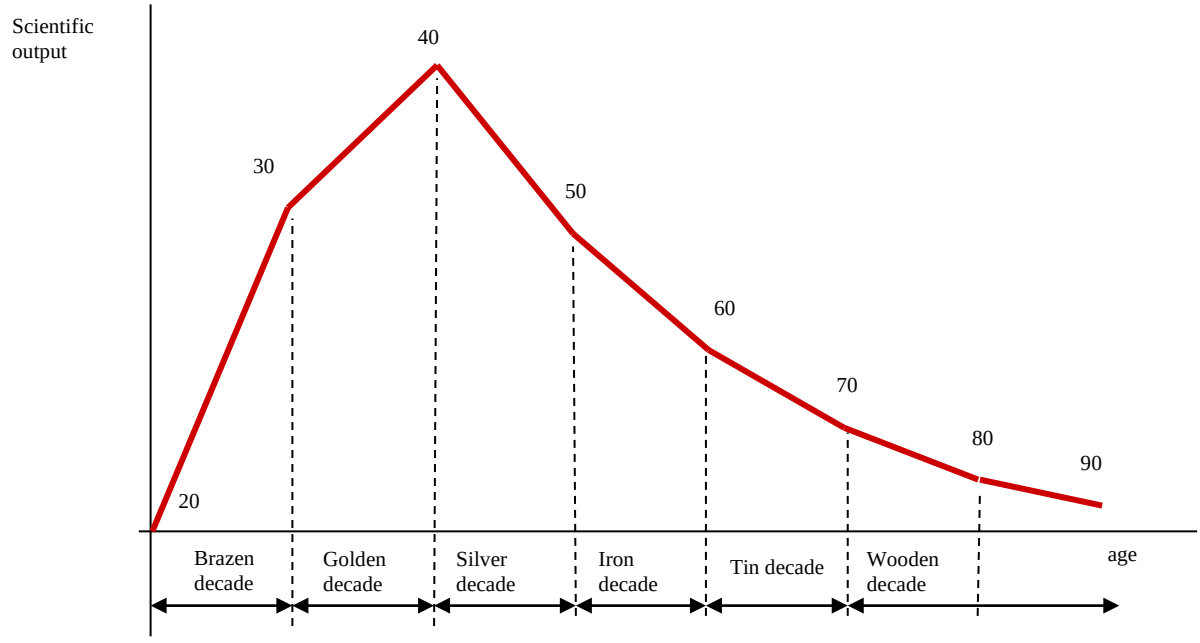

Figure 1 Graphical illustration of the *Beard's Law*

older age. As examples, heading the departments or faculties, membership in scientific or advisory boards or refereeing can be mentioned. All these functions undoubtedly reduce the time, otherwise available for research. To illustrate this point, let us look at Goodwin and Sauer's study. They compared productivity of individuals who accepted the position of department head ten years after finishing their Ph.D. and other individuals, who haven't accepted such function. According to that research, immediately after becoming a head of department, the publication activity drops to less than half of previous level. Moreover, even if the scientist returns to a normal status after 5 years, his productivity remains still very low. *Once one's attention is allocated to other duties for a sustained period of time, the individual's stock of research capital has been substantially depreciated. The previous level of productivity is never recovered* (Goodwin and Sauer, 1995).

Of course, there can be found several arguments in the literature, which are not necessarily in favor with Beard's law. Let me present two of them. The first one is connected with so called *reputational capital.*[4] If a scientist publishes significant papers at the start of his career, he gets a reputation which yields positive returns in subsequent periods. Such scientist gets better opportunities to get funding for further research, to get to a more prestigious institution, and to get better technical equipment. All these factors can increase his research productivity in the future. And even if the chief editors of famous scientific journals always assure of double-blind process when reviewing papers, it is possible that editors will prefer publicly known scientist instead of a not so famous one, even if the quality of their papers is the same.

One very important factor influencing the development of scientific performance through the life cycle is also the rewarding system in the academia. If a scientist is rewarded for his publications, one can assume that he will continue with his publication activity in the latter part of his life. Thus, it can be factor against the validity of Beard's law. However, if the rewarding system in the academia does not reward publication activity (or favors higher positions instead of high publication activity), it can motivate scientists to publish only at the start of their career to get to higher positions. *Most people will not continue an activity as arduous as scientific research unless they are rewarded for it* (Cole, 1979).

3. Age and productivity of Czech economists

In the Czech Republic, there have been significant papers on scientific performance of economists or academic institutions published recently[5]. However, they've been primarily aimed on the differences in publication activity of economists, departments,

[4] The term *reputational capital* was probably used by Robert Merton for the first time (see Merton, 1968).

[5] See especially the work of Gregor and Schneider (2005), Gregor (2006), Münich (2006), Turnovec (2005, 2007) and Macháček and Kolcunová (2005, 2008).

faculties etc, but age or academic career were not taken into account. Probably the only attempt to examine the relationship between age (or academic career) and scientific performance of Czech economists was Wroblowský (2008). Although in this paper quite simple research methods are used, it can be taken as a starting point for further research.

As a source of data, the ISI-Web of Knowledge database for the sample of Top 50 economists according to publication score (Turnovec, 2005) was used. It can be assumed that those economists generated a significant number of significant publications during their life and academic career. However, the sample does not contain *hardcore economists* only, but also scientists who make their research in the field of economics, although their specialization is in a different science (mathematicians, statisticians etc.). For each economist of the sample it was necessary to get the year of the birth. In most cases, those years were derived from official personal websites. When such data were not available, scientists were contacted and asked to provide it. From those economists, only one of them refused to provide his year of birth. The same procedure was used with obtaining the years of their PhD's.

First, let us turn the attention to the simple age – productivity relationship. For each age from 24 to 64, the average number of publications was computed for the sample.[6] The results of research are shown in Figure 2.

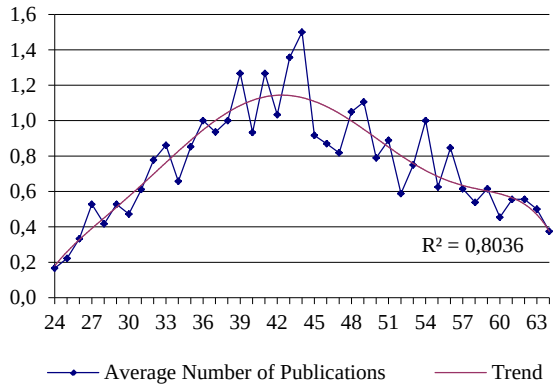

Figure 2 Age and scientific performance of Czech economists

It is vital to mention that the quality of publications was not a part of this research, so each publication received the same value, no matter where it was published. In the case of multi-authored papers, the proportional value was given to each author. Obtained results confirm the validity of Beard's law. Another graphical illustration of the publication activity in different ages can be obtained using four-year intervals. Results are shown in Figure 3.

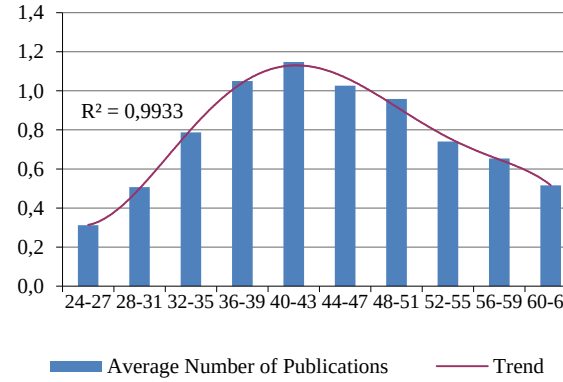

Figure 3 Life-cycle and publication activity of Czech economists – intervals

As mentioned before, recent theories state that the decline in publication activity in not caused by age itself, but rather by situations and events during scientists academic career, which are usually connected with higher age. Thus, it is necessary to draw attention from human age to the development of academic career. For this part of research, we use the same sample, but instead of age interval the period starting five years before the dissertation and ending 25 years after it is used. Obtained results are shown in Figure 4.

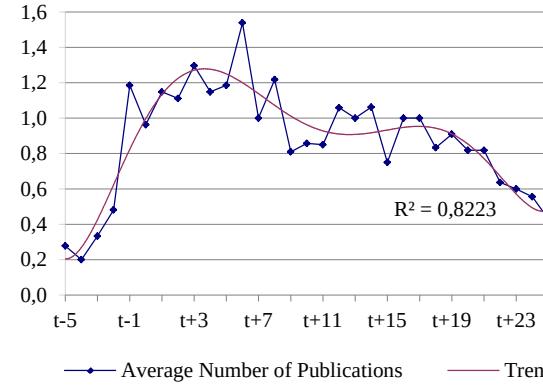

Figure 4 Publication activity and academic career of Czech economists

Although the decline of the scientific performance is not so significant (compared with the simple age-output relationship), it is obvious that the publication activity declines in the later phase of academic career. Before we provide possible explanations of such shape

[6] This research was done using all publications available in the ISI-Web of Knowledge database at the end of the year 2008.

of career-output curve, let we again show the same relationship using four year intervals[7] in Figure 5.

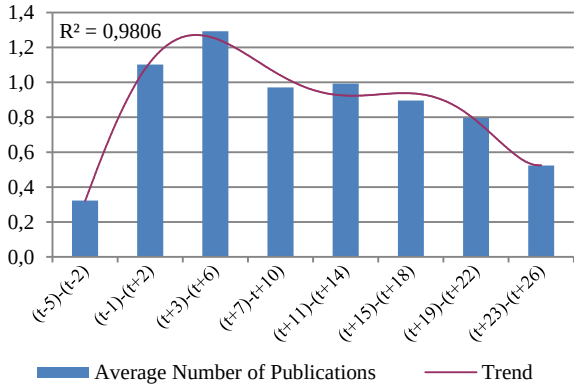

Figure 5 Publication activity and academic career of Czech economists – intervals

4. Interpreting the results

If we look at the simple age – productivity relationship, expected results were obtained. Publication activity of Czech economists grows in the first part of their life-cycle and declines in the latter one. However, there can be found several details that are specific (compared with other studies) for the Czech Republic. What can be found most interesting is that the Czech economists reach the peak in their productivity in the higher age, compared with the results of all other available studies. Also the fact that average economist belonging to the 60–63 age interval is more productive than average economist in the 28–31 interval, can be taken as surprising. Although it is difficult to provide one final explanation of that, it can be caused by the specific situation of post-socialist countries. A significant number of scientists from the sample are people who lived part of their academic career before the *velvet revolution*. In that time, their chance to get the necessary literature, to do independent research and to publish in prestigious foreign journals was low, if even not-existing. This factor can cause a significant bias in obtained results.

A relationship between productivity and phase of academic career is not surprising. Productivity dramatically increases before the dissertation, which is a result of the need of publishing to get the PhD benefits from increased research activity before the dissertation appear in following years (thus, the number of papers published remains almost constant or even slightly increases), but as soon as this effect disappears, productivity declines.

5. Conclusion

The results obtained for the community of Czech economists confirm findings of Dalen (1997b) that economics is a *young man's game*. He states that *...the average Nobel laureate is equipped with the following blessings: talent, an independent or an outsider's mind, a love for risky projects, a nose for being at the right place in the right time, the gift to see the fundamental problems and, last but not least, luck*. However, those attributes are not necessary for Nobel Prize laureates only, but generally for any successful economist. And although it can be a speculation only, we think that a young economist has much better chance to have those attributes than an older one.

For the future, there still remain opportunities for research in the field of scientific productivity of Czech economists. At first, it will be useful to try to include the quality of published papers. Second, by working with all publications (i. e. not only with those published in journals with impact factor) the sample of economists can be widened. It would be interesting to see the comparison of the age-productivity relationship of the *high-publishers* and *low-publishers*, but the sample used in this paper is too small for such research. Also a relationship between productivity and the age of becoming associate professors or professors can be a subject of further research.

[7] Compared with the Figure 4, the interval was modified by adding one more year to get partial intervals with the same length of 4 years.

References

BEARD, G.M. (1874). *Legal Responsibility in Old Age*. New York: Russels.

BEARD, G.M. (1881). *American Nervousness, Its Causes and Consequences*. New York: Putnam. http://dx.doi.org/10.1037/10585-000

COLANDER, D.C. (1989). Research on the Economic Profession. *Journal of Economic Perspectives* 3: 137–148.

COLE, S. (1979). Age and Scientific Performance. *American Journal of Sociology* 84: 958–977. http://dx.doi.org/10.1086/226868

DALEN, H.P. VAN (1997a). Measuring Giants and Dwarfs–Assessing the Quality of Economists. *Scientometrics* 38: 231–252. http://dx.doi.org/10.1007/BF02457411

DALEN, H.P. Van (1997b). The Golden Age of Nobel Economists. *Tinbergen Institute Discussion Paper*, 97/120–1.

DIAMOND, A.M. (1984). An Economic Model of the Life-Cycle Research Productivity of Scientists. *Scientometrics* 3(6): 189–196. http://dx.doi.org/10.1007/BF02016762

GOODWIN, T.H., SAUER, R.D. (1995). Life Cycle Productivity in Academic Research: Evidence from Cumulative Publication Histories of Academic Economists. *Southern Economic Journal* 62: 728–743. http://dx.doi.org/10.2307/1060993

GREGOR, M. (2006). Hodnocení ekonomických pracovišť a ekonomů: Koho, proč, čím a jak. *Politická ekonomie* 3(54): 394–414.

GREGOR, M., SCHNEIDER, O. (2005). The World is Watching: Rankings of Czech and Slovak Economic Departments. *Finance a úvěr – Czech Journal of Economics and Finance* 11–12(55): 518–530.

LEHMAN, H.C. (1953). *Age and Achievement*. Princeton: Princeton University Press,.

MACHÁČEK, M., KOLCUNOVÁ, E. (2005). Jak se v ČR žije kandidátům na docenty a profesory? Analýza publikačních aktivit v ekonomických disciplínách. *Finance a úvěr – Czech Journal of Economics and Finance* 11–12(55): 563–577.

MACHÁČEK, M., KOLCUNOVÁ, E. (2008). Hirschovo číslo a žebříčky českých ekonomů. *Politická ekonomie* 2(56): 229–241.

MERTON, R.K. (1968). The Mathew Effect in Science. *Science* 3810(159): 56–63. http://dx.doi.org/10.1126/science.159.3810.56

MÜNICH, D. (2006). Measuring Economics Research in the Czech Republic, a Comment. *Finance a úvěr – Czech Journal of Economics and Finance* 11–12(56): 522–533.

OSTER, S., HAMERMESH, D.S. (1998). Aging and Productivity among Economists: Note. *Review of Economics and Statistics* 1(80): 154–156. http://dx.doi.org/10.1162/003465398557258

TURNOVEC, F. (2005). Institucionální vědecký kapitál a individuální výkonnost ekonomů v ČR. *Finance a úvěr – Czech Journal of Economics and Finance* 11–12(55): 531–546.

TURNOVEC, F. (2007). Publication Portfolio of the Czech Economists and Problems of Rankings. *Ekonomický časopis* 7(55): 623–645.

WROBLOWSKÝ, T. (2008). Životní cyklus a vědecká výkonnost českých ekonomů. In *Nové trendy, nové nápady*, Znojmo: SVŠE, 389–395.

ZUCKERMAN, H., MERTON, R.K. (1972). Age, Aging, and Age Structure in Science. In Merton, R.K. (ed): *The Sociology of Science*. Chicago: University of Chicago Press, 497–560.

Additional sources

BRESCHI, S., LISSONI, F., MONTOBBIO, F. (2004). *The Scientific Productivity of Academic Inventors: New Evidence from Italian Data*. Available at ftp://ftp.unibocconi.it/pub/RePEc/cri/papers/WP168BreschiLissoniMontobbio.pdf.